NASA TECH BRIEF

Generalized Newton–Raphson Trajectory Optimization-Generator I

The problem:

To devise a method to replace the precise integration of the nonlinear motion and Euler–Lagrange equations used in previous indirect approaches to the optimal solution of trajectory problems. In these methods, optional switching points for changing from the thrust-on modes to the thrust-off modes are determined by monitoring a coasting-switch function.

The solution:

A computer program designed to construct a sequence of optimal solutions to dynamically-approximate linear equations, the sequence converging to the solution of the nonlinear problem. Without significant loss in generality, specification of the number and type of subarcs in the optimal solution allows simultaneous satisfaction of all switching criteria and removes from this technique the objectional sensitivities of a monitored switch function.

How it's done:

The Generalized Newton–Raphson scheme is formulated for the two-dimensional, vacuum-flight trajectory in which it is desired to minimize the expenditure of mass required to fulfill a given mission. The formulation is developed for the following mission options: (1) rendezvous with a passive satellite in circular orbit; and (2) transfer to a circular orbit of specified altitude, with flight time and range angle at injection free.

Optimum orbit transfer and rendezvous, from any initial condition to circular orbit, including optimum time to initiate and terminate coasting arcs, can be accomplished in one process with crude initial starting functions. The extremely wide area of convergence for this technique significantly increases the probability of obtaining a solution and reduces the manhours and computer time required to a level far below that necessary with all other techniques.

Notes:

1. This program is written in Fortran H for use on the IBM 360 computer.
2. Inquiries should be directed to:
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   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10422

Patent status:

No patent action is contemplated by NASA.

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